



# Entry Liberalization and Inequality in Industrial Performance

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# ENTRY LIBERALIZATION AND INEQUALITY IN INDUSTRIAL PERFORMANCE

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## Abstract

Industrial delicensing, which began in 1985 in India marked a discrete break from a past of centrally planned industrial development. Similar liberalization episodes are taking place across the globe. We develop a simple Schumpeterian growth model to understand how firms respond to the entry threat imposed by liberalization. The model emphasizes that firm responses, even within the same industrial sector, are likely to be heterogeneous leading to an increase in within industry inequality. Technologically advanced firms and those located in regions with pro-business institutions are more likely to respond to the threat of entry by investing in new technologies and production processes. Empirical analysis using a panel of three-digit state-industry data from India for the period 1980–1997 confirms that delicensing led to an increase in within industry inequality in industrial performance. (JEL: F14, O12, O31)

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## 1. Introduction

Economic liberalization is happening across the globe. Within the same industrial sector, firms that have different technological capabilities or that are located in regions with different types of institutions may respond in a heterogeneous manner to the competitive pressure imposed by the removal of barriers to entry during liberalization episodes. In short, the effects of liberalization may be unequal—some firms may benefit whilst others suffer, leading to growing within industry inequality in industrial performance. This paper looks directly at this issue from both a theoretical and empirical standpoint. In doing so it departs from much

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of the recent literature that attempts to evaluate the average effects of economic liberalization on industrial performance.<sup>1</sup>

To guide our research we construct a simple version of a Schumpeterian growth model with entry threat. How firms respond to this entry threat by investing in new technologies and production processes will be determined by two sets of factors, one internal to firms and the other external. Technological capability of firms determines their ability to compete with potential entrants. Firms close to the technological frontier will be incentivized to invest and innovate while those far from frontier will be disincentivized. The institutional environment in which firms operate, which is captured, for example, by the extent to which labor institutions are pro-employer in a given region, will also affect the extent to which they respond to entry threats via investment and innovation. For these reasons, as entry barriers come down with liberalization we expect to observe growing divergence in economic performance across industries within the same industrial sector but located in different regions of a country.

It is this core prediction of entry liberalization leading to rising within industry inequality that we take to the data. To do this we exploit a three-digit state-industry panel data set gathered by the Annual Survey of Industries in India for the period 1980–1997. In the period since independence in 1947, India remained a relatively closed economy with an extensive role for central planning of industry via licensing and other instruments. The delicensing reforms of Rajiv Gandhi in 1985 and the more substantial entry liberalization of 1991 marked a discrete break with the past. To capture entry liberalization we construct a delicensing measure that records when a given three-digit industry was delicensed. We then relate this measure to inequality in economic performance across three-digit state-industries within the same three-digit industrial sector. This enables us to examine directly whether the reduction in barriers to entry led to a divergence in industrial performance across Indian states within the same three-digit industrial sector as is predicted by the model.

The paper is structured as follows. Section 2 presents some theory that enables us to examine how the removal of barriers to entry affects industrial performance depending on the technological capacity of firms and their institutional environment. Section 3 presents empirical analysis of the link between entry liberalization and within industry inequality using an Indian three-digit state-industry panel for the period 1980–1997. Section 4 concludes.

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1. See, for example, Pavcnik (2002), Topalova (2004), and the survey in Tybout (2003). This paper reviews and highlights aspects of recent research pursued in a companion paper (see Aghion, Burgess, Redding, and Zilibotti 2004) to which the reader is referred.

## 2. The Model<sup>2</sup>

Consider the following version of the Schumpeterian discrete-time model of Acemoglu, Aghion, and Zilibotti (2005). The model economy consists of a set of “states” (or regions) that differ in their factor endowments, distribution of productivities across firms and labor market regulations.

All agents live for one period. In each period  $t$  a final good (henceforth the numeraire) is produced in each state by a competitive sector using a continuum one of intermediate inputs, according to the technology:

$$y_{s,t} = \frac{1}{\alpha} \left[ \int_0^1 (A_{s,t}(v))^{1-\alpha} x_{s,t}(v)^\alpha dv \right].$$

$x_{s,t}(v)$  is the quantity of intermediate input produced in sector  $v$ , state  $s$ , and date  $t$ ,  $A_{s,t}(v)$  is a productivity parameter that measures the quality of the intermediate input  $v$  in producing the final good, and  $\alpha \in (0, 1)$ . The final good can be used either for consumption, or as an input in the process of production of intermediate goods, or for investments in innovation. For simplicity, we drop the state index  $s$  when this is not a source of confusion.

In each intermediate sector  $v$  only one firm (a monopolist) is active in each period, and property rights over intermediate firms are transmitted within dynasties. A firm consists of an entrepreneur, who has the power to take decisions concerning production and investments, workers that for simplicity we assume to be in a fixed number, and a technology to transform one unit of the final good into one unit of intermediate good of productivity  $A_t(v)$ .

Standard analysis (see Acemoglu, Aghion, and Zilibotti 2005) shows that the surplus generated by this firm is equal to  $\alpha^{\frac{1}{1-\alpha}} (\frac{1-\alpha}{\alpha}) A_t(v)$ . Entrepreneurs and workers split this surplus according to the Nash rule. The share appropriated by each of the parties, say  $\beta$  and  $(1 - \beta)$ , depend on their bargaining strengths, which is assumed to depend on institutional features (state-specific labor legislation). Let  $\delta \equiv \beta \cdot \alpha^{\frac{1}{1-\alpha}} (1 - \alpha) / \alpha$ . The equilibrium profit appropriated by the entrepreneur is, then:

$$\pi_t(v) = \delta A_t(v).$$

Also, substituting for the equilibrium production level of each intermediate good,  $x_t(v)$ , in the production function for final output, we obtain the total output level  $y_t \alpha^{\frac{2\alpha-1}{1-\alpha}} A_t$  where  $A_t \equiv \int_0^1 A_t(v) dv$  is the average productivity in the state.

2. This model was first developed in Aghion, Burgess, Redding, and Zilibotti (2004).

### 2.1. Technological States, Innovation, and Entry

In every period, and within each state, intermediate firms differ in terms of their current distance to the world “technological frontier”. We denote the productivity of the frontier technology at the end of period  $t$  by  $\bar{A}_t$  and assume that this frontier grows at the exogenous rate  $g$ . More formally:

$$\bar{A}_t = \bar{A}_{t-1}(1 + g).$$

At the beginning of period  $t$  (or, identically, at the end of period  $t - 1$ ), the leading firm in the production of a particular intermediate input can be in two states: (i) “high-productivity” firms have a productivity level  $A_{t-1}(v) = \bar{A}_{t-1}$ , namely, are at the current frontier; (ii) “low-productivity” firms have a productivity level  $A_{t-1}(v) = \bar{A}_{t-2}$  namely, are one step behind it.

Before deciding their production plans, firms can undertake investments in technology adoption to increase their productivity. Innovative investments have a stochastic return. In case of success, the incumbent firm can adopt the next most productive technology, i.e., can increase its productivity by a factor  $1 + g$  and keep pace with the advancement of the technological frontier. The cost of technology adoption is assumed to be quadratic in the probability of success and linear in the level of technology:

$$c_t(v) = \frac{1}{2} z_t^2 A_{t-1}(v),$$

where  $z$  is the probability of success of the investment. If instead the investment is not successful (probability  $1 - z$ ), the firm produces with a productivity level equal to its initial state.

We make the following assumptions about firms’ dynamics. If an advanced firm is successful at  $t$ , it starts as an advanced firm at  $t + 1$ . All other firms start as backward firms (note that this implies that firms with a realized productivity equal to  $A_{t-2}$  at  $t$  automatically upgrade their initial productivity due to some spillover effect). However, in this case, with an exogenous probability  $h$ , the leader is replaced by a new firm starting as advanced at  $t + 1$ . Let  $a_t$  denote the proportion of “advanced” firms at  $t$ , and  $z_A$  denote the innovative investment of advanced firms. Then the productivity distribution is characterized by the following dynamics:

$$a_{t+1} = z_{A,t} a_t + h(1 - z_{A,t} a_t) = (1 - h) z_{A,t} a_t + h,$$

implying the steady-state proportion of advanced firms being equal to  $a^* = h/[1 - z_A(1 - h)]$ .

Intermediate firms are subject to competition from outsiders. In particular, we assume that, in every period, an outsider can operate a hit-and-run entry in

the local market for a particular intermediate good.<sup>3</sup> Outside firms observe the outcome of the innovative investment of the local firm, and face the following decision. They can either stay out of the market, or pay a small fixed cost,  $\zeta$ , and be granted permission to sell in the local market with probability  $\mu$ .<sup>4</sup> Outsiders are assumed to have the frontier productivity,  $\bar{A}_t$ .

If an outsider enters and competes with a low productivity firm, it steals all the market. If it competes with a high-productivity firm, however, Bertrand competition drives the profits of both firms to zero. We assume the parameters to be such that the outside firm will always find it profitable to try to enter if the market is controlled by a low-productivity firm. However, the outsider will not try to enter if there is a high-productivity incumbent. Therefore, the probability of entry in the market for input  $v$  will be zero, if the local firm  $v$  was initially “advanced” and has undertaken a successful innovative investment. Else, the probability is  $\mu$ .

## 2.2. Equilibrium Innovation Investments

We now consider the decisions of incumbent producers in each of the technological states. Recall that all agents live for one period only, therefore incumbent producers born at date  $t$  maximize the expected profits accruing at the end of the same period  $t$ . This is a useful simplification that avoids the need to solve more complicated dynamic problems.

Backward firms choose their investment so as to maximize expected profits, as given by:

$$\max_z \{ \delta [z(1 - \mu)\bar{A}_{t-1} + (1 - z)(1 - \mu)\bar{A}_{t-2}] - \frac{1}{2}z^2\bar{A}_{t-2} \},$$

whose solution yields:

$$z = \delta(1 - \mu)g = z_B. \quad (1)$$

Recall that backward firms can only make profits if there is no entry (probability  $1 - \mu$ ). The productivity is  $\bar{A}_{t-1}$  if the investment is successful (probability  $z$ ) and  $\bar{A}_{t-2}$  if the investment is not successful (probability  $1 - z$ ).<sup>5</sup>

3. A variant of this model with permanent entry is developed by Aghion, Blundell, Griffith, Howitt, and Brantl (2004), who then confront it with U.K. firm level data on entry threat, actual entry, patenting, and productivity growth.

4. We can interpret  $\mu$  as the probability of success of an application for a license or in overcoming other legal barriers to starting production.

5. One could generalize the model to allow for the possibility that through aggressive innovative investments backward firms can catchup with the frontier. This would create scope for defensive innovation from backward firms when the probability of entry increases. As long as the probability that backward firms can make large jumps is sufficiently low, this extension would not change qualitatively the comparative statics of the model.

Advanced firms choose their innovation investment in order to solve the following program:

$$\max_z \{ \delta [z \bar{A}_t + (1-z)(1-\mu)\bar{A}]t - 1 \} = \frac{1}{2} z^2 \bar{A}_{t-1}$$

whose solution yields:

$$z = \delta(g + \mu) = z_A \quad (2)$$

In this case, incumbent firms can prevent entry by successfully adopting the last technology, which occurs with probability  $z$ . In this case, the local firm has a productivity level  $\bar{A}_t$ . The firm also retains the market if the investment is not successful, but there is no entry. This event occurs with probability  $(1-\mu)(1-z)$ . In this case the firm's productivity is  $\bar{A}_{t-1}$ .

We interpret an increase of the entry threat,  $\mu$  as a liberalization reform. Straightforward differentiation of equilibrium innovation intensities with respect to  $\mu$  yields:

$$\frac{\partial z_A}{\partial \mu} = \delta > 0 \text{ and } \frac{\partial z_B}{\partial \mu} = -\delta g < 0. \quad (3)$$

In other words, increasing the entry threat (e.g., through slashing barriers to entry via delicensing) encourages innovation in advanced firms and discourages it in backward firms. The intuition for these comparative statics is immediate. The higher the threat of entry, the more important innovations will be in helping incumbent firms already close to the technological frontier to retain the local market. However, firms that are already far behind the frontier have no chance to win over a potential entrant. Hence, a higher threat of entry will only lower the expected net gain from innovation, thereby reducing the incentive for the incumbent to invest in innovation.

Next, consider the effects of changes in labor market regulations on innovative investments. "Pro-worker" regulations are captured by smaller  $\delta$ 's, as discussed previously. It is immediate that

$$\frac{\partial z_A}{\partial \delta} = g + \mu > 0 \text{ and } \frac{\partial z_B}{\partial \delta} = (1-\mu)g > 0.$$

Hence, pro-worker labor market regulations discourage innovation in all firms, but they do so to a larger extent in advanced firms.

### 2.3. Predictions for State-Industries

We have so far assumed, for simplicity, that there is only one sector of activity. The stylized model presented here can be reinterpreted as describing a single industry rather than the economy as a whole. Each state-industry should then be

viewed as an “island” populated by a set of competitive final producers and a set of noncompetitive differentiated intermediated producers. The products of different industries are perfect substitutes in consumption, and the price of all final goods is set equal to unity. Thus, the equilibrium described in this section, as well as its comparative statics, can be regarded as the equilibrium of a state-industry. The average productivity of firms in state-industry is  $A_{i,s,t} = \int_0^1 A_{i,s,t}(v)dv$ .

Steady-state productivity differences across state-industries are assumed to be driven by idiosyncratic state-industry effects affecting the exogenous probability of upgrading,  $h$ , and in the state-specific parameter  $\beta$  labor market regulation). More formally,

$$a_{i,s}^* = \frac{h_{i,s}}{1 - z_{A_{i,s}}(1 - h_{i,s})},$$

where  $h_{i,s} = h + \varepsilon_{i,s}$ . This representation allows us to introduce in a parsimonious way steady-state productivity differences across state-industries: more advanced state-industries (conditional on labor market regulations) are those with high  $h_{i,s}$ 's. The model's predictions for firm behavior now hold at the level of state-industries (see Aghion, Burgess, Redding, and Zilibotti 2004).

### 3. The Unequal Effects of Liberalization<sup>6</sup>

State control of Indian industry was enshrined in the Industries (Development and Regulation) Act of 1951 whereby firms required a licence in order to establish a new factory, to expand capacity by more than 25% of existing levels, or to manufacture a new product. These controls were supplemented with state controls on financial intermediation, imports, foreign direct investment, and high tariff and nontariff barriers as part of an overall strategy of centrally planned industrial development. Licensing enabled the state to control the pattern of industrial development across Indian states and to address regional disparities. India lived under this “License Raj” for the bulk of its postcolonial history; however, slow growth in the late-1960s and 1970s (see Table 1) generated pressure for change culminating in Rajiv Gandhi's reforms of the mid-1980s where one-third of Indian three-digit manufacturing industries were exempted from industrial licensing. A growing fiscal and balance of payment crisis (which necessitated intervention by the IMF) and the assassination of Rajiv Gandhi, which led to the appointment of Narasimha Rao to Prime Minister and of Manmohan Singh to Finance Minister precipitated more dramatic internal and external liberalization in 1991. Compulsory industrial licensing was abolished in all but a few industries so that, as of 1991, 85% of all three-digit manufacturing industries were delicensed. There were also significant

6. This section is based on Aghion, Burgess, Redding, and Zilibotti (2004).



TABLE 1. Economic growth in India, 1960–1997.

	Annual growth SDP per capita	Annual growth manufacturing SDP per capita	Annual growth registered manufacturing SDP per capita
1960–1970	2.82%	1.89%	2.58%
1970–1980	1.53%	3.90%	3.39%
1980–1985	2.90%	4.17%	5.78%
1985–1990	3.76%	5.68%	6.92%
1991–1997	4.06%	6.90%	8.19%

Notes: SDP denotes real state domestic product. Nominal domestic product in each state is deflated using a rural-urban population weighted average of the consumer price indices for industrial workers and agricultural laborers. Registered manufacturing corresponds to all factories with more than 10 employees with power or more than 20 employees without power. The data source is Besley and Burgess (2004).

reductions in tariff and nontariff barriers and a loosening of controls on imports and foreign investment.

State panel data for the period 1960–1997 from Besley and Burgess (2004) suggests that economic liberalization was associated with rising economic growth, particularly in the manufacturing sector (see Table 1).<sup>7</sup> Figure 1 examines the evolution of cross-state inequality by graphing out the standard deviation of log registered and unregistered manufacturing output per capita for the years 1960 to 1997. The distinction between these two sectors is germane as the unregistered (informal) sector of small firms is not subject to licensing controls whereas the registered (formal) sector of larger firms is.<sup>8</sup> Inequality in registered manufacturing output declines from 1960 until 1985 and then increases up to 1997. In line with the predictions of the model we see that delicensing post-1985 is associated with rising inequality in the regulated manufacturing sector.<sup>9</sup> In contrast, inequality in the unregulated manufacturing sector rises across the whole period.

Using Indian Annual Survey of Industries data we can carry out a similar exercise looking at inequality across states within three-digit registered manufacturing industries. To do this we calculate the standard deviation across states of log gross output and output per employee within a three-digit manufacturing industry for each year between 1980 and 1997. Figure 2 graphs the three-year moving average of the median of these within-industry standard deviations across this period. Consistent with the model we observe growing inequality following the 1985 delicensing reforms, with the within industry inequalizing effects of liberalization becoming particularly strong post-1991.<sup>10</sup>

7. See Rodrik and Subramanian (2004) and Topalova (2004).

8. Manufacturing firms with more than ten employees with power or with more than twenty without are classified as registered whereas firms below these cutoffs are classified as unregistered.

9. The falling trend pre-1985 reflects the use of licensing and other state controls to reduce regional disparities in industrial development.

10. These findings concerning aggregate and within-industry inequality are robust to considering alternative measures of dispersion such as the coefficient of variation or the difference in log output,

TABLE 2. Delicensing, entry and within-industry inequality.

	1	2	3	4	5
	Number of factories	St dev In(Y)	St dev In(Y/L)	St dev In(TFPI)	St dev In(TFP2)
Industry delicensed	87.581*** (36.311)	0.131*** (0.040)	0.066*** (0.021)	0.051** (0.024)	0.052** (0.025)
Observations	1,764	1,764	1,764	1,764	1,764
R-squared	0.97	0.65	0.64	0.37	0.37
Industry fixed effects	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES

Notes: sample is an industry-time panel on three-digit manufacturing industries during 1980–1997 from the Indian Annual Survey of Industries (ASI). See Aghion, Burgess, Zilibotti, and Redding (2004). Industry delicensed is an industry-time measure of delicensing, which takes the value 1 if the industry is delicensed in a particular year and 0 otherwise. Number of factories is the number of factories active in an industry and year. St Dev denotes the standard deviation across states within an industry and year. In(Y) is log real gross output. In(Y/L) is log real gross output per employee. In(TFPI) is log superlative index Total Factor Productivity. In(TFP2) is log superlative index Total Factor Productivity, including nonproduction and production workers as separate factors of production. Output, employees and other factor inputs are from the ASI. Price deflators are from the Handbook of Industrial Statistics. Standard errors in parentheses are heteroscedasticity robust and adjusted for clustering on industry.

\*significant at 10%.

\*\* significant at 5%.

\*\*\* significant at 1%.

To directly link within three-digit industry inequality to industrial delicensing we run regressions of the form:

$$y_{it} = \text{delic}_{it} + d_t + v_i + u_{it}$$

where  $i$  denotes a three-digit registered manufacturing industry and  $t$  year,  $y_{it}$  is an economic outcome of interest,  $\text{delic}_{it}$  is a 0/1 dummy that switches on when a three-digit industry is delicensed,  $d_t$  is a year dummy that controls for common macro-economic shocks and will capture the overall effects of the 1985 and 1991 liberalizations across all three-digit industries,  $\eta_i$  is an industry fixed effect that controls for unobserved heterogeneity across three-digit industries, and  $u_{it}$  is a stochastic error. To allow for heteroscedasticity and serial correlation in the error term over time, the standard errors are corrected for clustering at the three-digit industry level. This is a “differences in differences” specification, where the effect of delicensing is identified from the differential change over time in the economic outcome in industries that delicense relative to industries where compulsory industrial licensing is retained.

The  $\text{delic}_{it}$  measure corresponds to the probability of entry measure  $\mu$  in the model. We would therefore expect industrial delicensing to encourage entry.<sup>11</sup> Column (1) of Table 2 confirms this where we see that delicensing increases the

log output per capita, or log output per worker at the 90th and 10th percentiles of the cross-state distribution.

11. This view is confirmed in the Government of India’s own official reports (e.g., Reports of the 1969 Industrial Licencing Policy Enquiry Committee and the 1985 Narasimhan Committee on Replacement of Physical by Financial Controls).

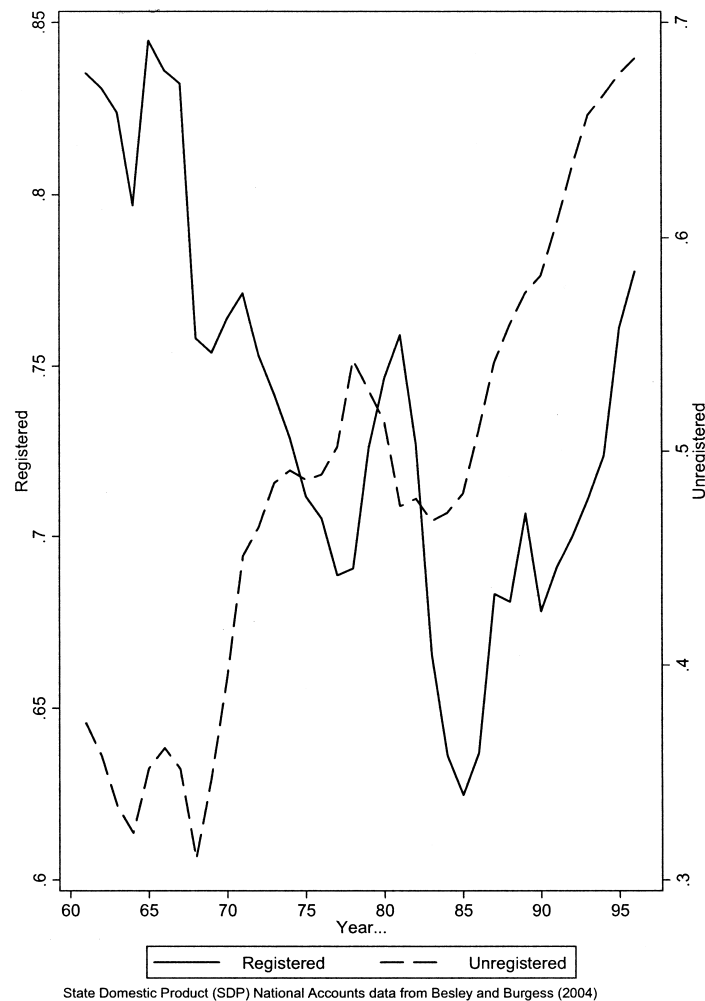


FIGURE 1. Standard deviation in log manufacturing SDP.

number of factories in a three-digit industry. We are now in a position to link entry liberalization to inequality in industrial performance within three-digit industries across states. Columns (2) and (3) shows that delicensing leads to an increase in within industry inequality in output and output per employee. Columns (4) and (5) show a similar pattern for two superlative index measures of total factor productivity.

This finding of rising inequality following entry liberalization is consistent with the theoretical model that emphasizes how a common reform may have uneven effects on the performance of state-industries within a given industrial

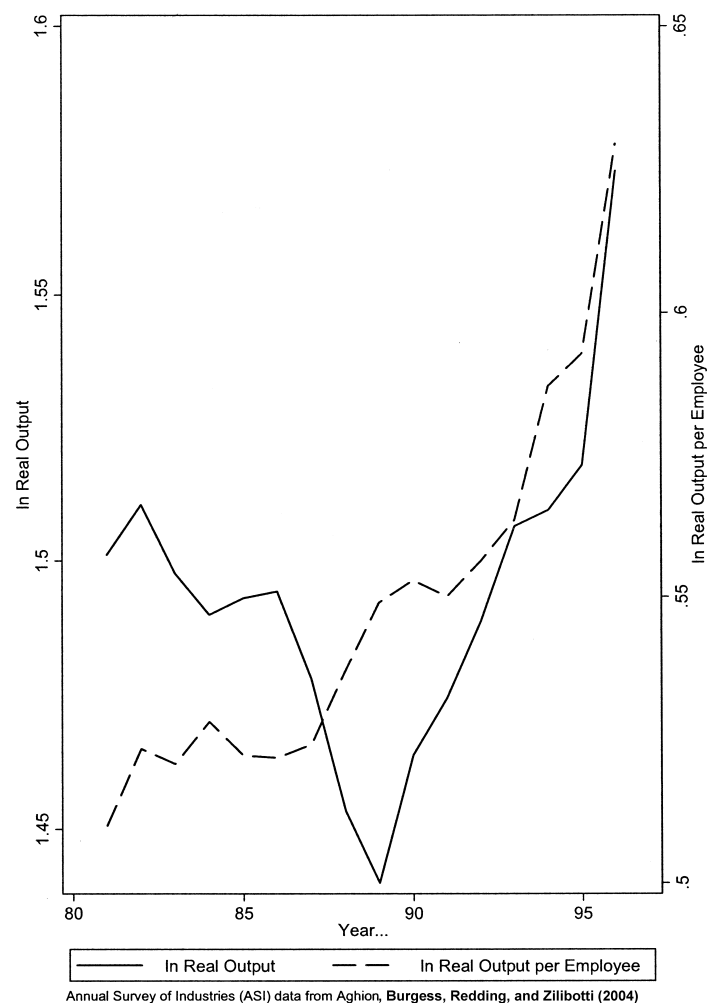


FIGURE 2. Median within industry standard deviation.

sector. In Aghion, Burgess, Redding, and Zilibotti (2004) we explore how a state-industry's distance to the Indian technological frontier and state specific labor market institutions can help us understand rising within three-digit industry inequality across the 1980–1997 period.<sup>12</sup>

12. The paper is contribution to the growing literature that emphasises that a firm's distance from the technological frontier will determine the extent to which it benefits from entry. Sabirianova, Svenjar, and Terrell (2004), for example, find that greater presence of foreign firms in a given industry has a negative average effect on the productive efficiency of Czech and Russian domestic firms but the effect is positive on the efficiency of other foreign-owned firms.

#### 4. Conclusions

The world has tended to divide between those who are for or against liberalization. Reality it turns out is more nuanced—there can be no a priori assumption that an industry in a particular region of a country will benefit from or be harmed by liberalization. Consistent with our theoretical model we find that entry deregulation elicited heterogeneous responses from industries in the same three-digit sector but located in different states of India. This is an important finding as it suggests that actions by firms to upgrade technological capability or by policymakers to improve the institutional environment will have a central bearing on whether industry in a given sector and state benefits from or is harmed by the process of economic liberalization. Identification of policies that enable local industry to benefit from economic liberalization is where the research frontier now lies. The combination of economic theory and microeconomic data sources, together with an emphasis on incentives and technology, provides a fruitful avenue for further research on the microeconomics of industrial development.

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